Members of the public wishing to address the Board are requested to complete a sign-up slip at the lobby information center. Statements shall not exceed three minutes, unless the Board President grants special permission.

AGENDA

SACRAMENTO MUNICIPAL UTILITY DISTRICT
BOARD OF DIRECTORS MEETING
SMUD CUSTOMER SERVICE CENTER
RUBICON ROOM - 6301 S STREET
SACRAMENTO, CALIFORNIA

December 21, 2017 – 6:00 p.m.

Call to Order.
a. Roll Call.

1. Approval of the Agenda.

2. Approval of the minutes of the meeting of November 16, 2017.

3. Committee Chair Reports.

   a. Committee Chair report of December 5, 2017, Finance and Audit Committee Present the Financial Statement for SMUD for the ten-month period ended October 31, 2017
   b. Committee Chair report of December 6, 2017, Energy Resources & Customer Services Committee
   c. Committee Chair report of December 19, 2017, Strategic Development Committee
   d. Committee Chair report of December 20, 2017, Policy Committee

Item 5 was reviewed by the Finance and Audit Committee on November 7, 2017. Item 6 was reviewed by the Policy Committee on November 15, 2017. Item 7 was reviewed by the Finance and Audit Committee on December 5, 2017. Item 8 was reviewed by the Energy Resources & Customer Services Committee on December 6, 2017. Items 9 through 13 were reviewed by the Strategic Development Committee on December 19, 2017. Item 14 was reviewed by the Policy Committee on December 20, 2017. Items 15.a. and 15.b. were reviewed by the Finance and Audit Committee on November 7 and 8, 2017, and December 5, 2017.

Comments from the public are welcome when these agenda items are called.

Consent Calendar:

4. Approve Board member compensation for service rendered at the request of the Board (pursuant to Resolution 02-12-14) for the period of November 16, 2017, through December 15, 2017.

5. Adopt **SMUD's Pay Schedule** and **Special Compensation** items for employees pursuant to California Code of Regulations, Title 2, sections 570.5 and 571(b). **Finance and Audit Committee 11/7. (Jennifer Davidson)**

6. Approve revisions to **Strategic Direction SD-16, Information Management and Security Policy**. **Policy Committee 11/15. (Stephen Clemons)**

7. Authorize the Chief Executive Officer and General Manager to award a contract to **Cape Environmental Management Inc. (CAPE)** for Station E Substation – Phase 1b waste excavation and rough grading for a contract term from January 2, 2018 through August 31, 2018, in a not-to-exceed amount of $12,579,798. **Finance and Audit Committee 12/5. (Gary King)**

8. Adopt new **Strategic Direction SD-19, Diversified Business**. **Energy Resources & Customer Services Committee 12/6. (President Slaton)**

9. Accept the monitoring report for **Strategic Direction SD-7, Environmental Leadership**. **Strategic Development Committee 12/19. (Gary King)**

10. Accept the monitoring report for **Strategic Direction SD-9, Resource Planning**. **Strategic Development Committee 12/19. (Paul Lau)**

11. Accept the monitoring report for **Strategic Direction SD-10, Research and Development**. **Strategic Development Committee 12/19. (Paul Lau)**

12. Approve Change Order No. 03 to Contract No. 4500100583 with **Bayview Environmental Services, Inc.** to increase contract scope for Demolition and Abatement Construction Services of the SMUD Headquarters Building, increase the contract amount by $2,667,497 from $8,553,394 to $11,220,891, and extend the contract term from December 31, 2017, through February 28, 2018. **Strategic Development Committee 12/19. (Gary King)**

13. Approve Contract Change No. 04 to Contract No. 4500103555 with **Roebbelen Contracting, Inc. (Roebbelen)** to authorize the SMUD Contracting Officer to issue a Notice to Proceed to **Roebbelen** for the Construction Work, incorporate the construction Guaranteed Maximum Price (GMP), onboard the associated construction subcontractors, and increase the contract amount by $71,361,101 from $1,297,959 to $72,659,060, and reflect Final Completion by March 2019. **Strategic Development Committee 12/19. (Gary King)**

14. Approve revisions to **Board-Staff Linkage BL-14, Delegation to the General Manager With Respect to Customer Products, Services and Programs**. **Policy Committee 12/20. (Arlen Orchard)**

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Discussion Calendar:

15. Adopt the following:

    a. **2018 Budget** which, among other things, establishes:

    - An Operations and Maintenance Budget of $1,035.3 million (including Public Goods Charge of $55.0 million);
    - A Debt Service Budget of $181.1 million;
    - A Capital and Reserve Budget of $519.4 million; and
    - Authorized contingencies.

    b. Declaration of Intent to Issue Debt to create $300 million of additional bonding authority to reimburse for qualifying capital expenditures, and Official Intent to reimburse for 2018 and 2017 capital expenditures from bond proceeds, which is required to maintain tax-exempt financing capability.

    Finance and Audit Committee 11/7, 11/8 and 12/5. (Jennifer Davidson)

16. Discuss possible merit increase to the Chief Executive Officer and General Manager's base salary and/or performance bonus, pursuant to the Chief Executive Officer and General Manager's employment contract. **(President Slaton)**

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Public Comment:

17. Statements from visitors (non-agenda items).

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Board and CEO Reports:

18. Directors' Reports.

19. President's Report.

20. CEO's Report.
    a. Scholarship Award Presentations
    b. Board Video re: A Look Back at 2017

Summary of Board Direction

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FOLLOWING ADJOURNMENT OF THE FOREGOING SMUD BOARD OF DIRECTORS MEETING, SPECIAL MEETINGS OF THE FOLLOWING JOINT POWERS AGENCIES WILL CONVENE:

CENTRAL VALLEY FINANCING AUTHORITY
NORTHERN CALIFORNIA GAS AUTHORITY NUMBER 1
SACRAMENTO COGENERATION AUTHORITY
SACRAMENTO MUNICIPAL UTILITY DISTRICT FINANCING AUTHORITY
SACRAMENTO POWER AUTHORITY

* * * * * * *

Board Committee Meetings and Special Meetings of the Board of Directors are held at the SMUD Customer Service Center, 6301 S Street, Sacramento

December 19, 2017	Strategic Development Committee and Special Board of Directors Meeting	Rubicon Room*	5:30 p.m.
December 20, 2017	Policy Committee and Special Board of Directors Meeting	Rubicon Room	5:30 p.m.
January 9, 2018	Finance and Audit Committee and Special Board of Directors Meeting	Rubicon Room*	5:30 p.m.
January 10, 2018	Energy Resources & Customer Services Committee and Special Board of Directors Meeting	Rubicon Room	5:30 p.m.

* * * * * * *

Regular Meetings of the Board of Directors are held at the SMUD Customer Service Center, 6301 S Street, Sacramento

January 18, 2018 Rubicon Room 9:00 a.m.

**The Rubicon Room is located on the first floor of SMUD Customer Service Center, 6301 S Street, Sacramento, CA*

Members of the public wishing to address the Board should complete a sign-up form available at the table outside of the meeting room. Members of the public shall have up to three (3) minutes to provide public comment on items on the agenda or items not on the agenda, but within the jurisdiction of SMUD. The total time allotted to any individual speaker shall not exceed nine (9) minutes.

Members of the public wishing to inspect public documents related to agenda items may call 916-732-7143 to arrange for inspection of the documents at the SMUD Customer Service Center, 6301 S Street, Sacramento, California.

NOTE: Accommodations are available for the disabled public. If you need a hearing assistance device or other aid, please call 916-732-7143 in advance of this Board Meeting.

SACRAMENTO MUNICIPAL UTILITY DISTRICT

OFFICE MEMORANDUM

TO: Board of Directors **DATE:** September 21, 2017

FROM: Claire Rogers

SUBJECT: **Audit Report No. 28006571**
Board Monitoring Report; SD-09: Resource Planning

Audit and Quality Services (AQS) reviewed the SD-09 Board Strategic Direction on Resource Planning 2016 Annual Monitoring Report. AQS performed the following review steps:

- Reviewed the information presented in the monitoring report to determine the possible existence of material misstatements;
- Interviewed report contributors and verified the methodology used to prepare the monitoring report; and
- Validated the reasonableness of a selection of the report's statements and assertions.

During the course of the review, nothing came to the auditor's attention that would suggest the report did not fairly represent the source data available at the time of the review.

CC:

Arlen Orchard

Board Monitoring Report 2017
SD-9, Resource Planning

1. Background

It is a core value of Sacramento Municipal Utility District (SMUD) to provide its customer-owners with a sustainable power supply through the use of an integrated resource planning process. A sustainable power supply is defined as one that reduces SMUD's net long-term greenhouse gas (GHG) emissions to serve retail customer load to 350,000 tonnes (10% of its 1990 carbon dioxide emission levels) by 2050, while assuring reliability of the system, minimizing environmental impacts on land, habitat, water quality, and air quality, and maintaining a competitive position relative to other California electricity providers. In reducing its net GHG emissions, SMUD will utilize energy efficiency, renewable and net carbon free resources, including large hydroelectric resources and biogas. SMUD may also use offsets to support these goals to the extent their use is cost effective and beneficial to SMUD customers and the region.

To guide SMUD in its resource evaluation and investment, the Board sets the following interim goal:[1]

Year	Net Greenhouse Gas Emissions (tonnes)
2020	2,318,000

In keeping with this policy, SMUD shall also achieve the following:

A. SMUD's goal is to achieve energy efficiency equal to 15% of retail load over the next 10-year period. On an annual basis, SMUD will achieve energy efficiency savings of 1.5% of the average annual retail energy sales over the three-year period ending with the current year.

To do this, SMUD will acquire as much cost effective and reliable energy efficiency as feasible through programs that optimize value across all customers. SMUD shall support additional energy efficiency acquisition by targeting one percent (1%) of retail revenues for above market costs associated with education, market transformation, and programs for hard to reach or higher cost customer segments. The market value of energy efficiency will include environmental attributes, local capacity, value, and other customer costs reduced by an efficiency measure.

B. Provide dependable renewable resources to meet 33% of its load by 2020, and 50% of its load by 2030, excluding additional renewable energy acquired for certain customer programs. In acquiring renewable resources, SMUD shall emphasize local and regional environmental benefits.

C. Promote cost effective, clean distributed generation through SMUD programs.

[1] This goal does not take into account the potential impacts of transportation electrification.

2. Executive Summary

SMUD's IRP process has allowed SMUD to create a portfolio of resources, which balances reliability, environmental, financial, and customer objectives while achieving the goals set forth in SD-9 in a reasonable and affordable way. The metrics in the SD-9 help SMUD achieve its North Star objective of a Sustainable Future by helping to monitor and reduce its carbon emissions. SMUD continues to invest in the development and implementation of new programs and projects to meet all future goals and objectives.

This report demonstrates the ways in which SMUD complies with the goals set forth in the Resource Planning Strategic Directive (SD-9). **Currently, SMUD complies with each of the goals established in SD-9**. A detailed list of compliance for interim GHG reduction goals, energy efficiency (EE) savings, demand reduction (DR), renewable energy supply, and local environmental benefit objectives are summarized within this report.

In 2016, SMUD had normalized GHG emissions of 2.07 million metric tons. This puts SMUD well on the path to be below its 2020 SD-9 goal of 2,318,000. SMUD exceeded its EE goal of 158 GWh with 169 GWh of energy saved in 2016. Currently, SMUD is on track to meet its 2020 Renewable Portfolio Standard (RPS) target of satisfying 33% of retail sales with qualifying renewables. SMUD met its 2016 RPS target of 25% of retail sales with qualifying renewables.

Staff plans to return to the board next year with a new 2030 SD-9 target after they have had time to review the impacts and implications of the Air Resources Board's post-2020 greenhouse gas allocation allotment.

3. Additional Supporting Information

Sustainable Power Supply (GHG targets and Goal)

SMUD's adjusted GHG footprint in 2016 was approximately 2.07 million metric tons, and adjustments to the actual 2016 footprint include:

- Increase to account for higher than expected hydro and wind production
- Increase to account for lower energy usage by SMUD customers
- Decrease for using banked renewable energy credits (REC)

In 2016, SMUD used banked RECs to comply with California's RPS. In previous years, SMUD procured more renewable energy than required. This extra energy was saved or banked in accordance with RPS rules for use later. Using these banked RECs lowers SMUD's normalized emissions because any emissions impacts were realized at an earlier date. Table 1 summarizes actual emissions and adjustments to reflect normal weather conditions, expected energy usage, and the REC banking adjustment.

Table – 1 Carbon Footprint & Targets

2016 SD-9 Carbon Footprint & Near-term Targets (Tonnes)[2]		
Source	**Net Power (MWh)**	**CO2e Emissions (MT)**
Net Generation and Power Purchases[3]	12,553,882	2,915,110
Wholesale	(1,576,687)	(609,923)
SMUD Electric Sales, SMUD Usage and System Losses	***10,977,195***	***2,305,187***
Adjustment for Normal Load		4,187
Adjustment for Normal Wind and Hydro		116,871
REC Banking Adjustment		(353,735)
SMUD Normalized Total (estimate)		***2,072,510***
2020 Target		***2,318,000***

A. Meet Energy Efficiency Goals

2016 Energy Savings

SMUD's EE savings exceeded the SD-9 energy savings goals established for 2016. Table 2 summarizes energy savings from SMUD's residential and commercial energy efficiency programs.

Table 2 – Comparing 2016 Energy Savings with SD-9 Goals

Program Type	Energy Savings (Annual GWh)
Information & Education Savings	21.17
Existing Residential	73.12
Existing Commercial	63.91
New Construction	10.62
Shade Trees	0.37
Total	**169.19**
SD-9 Goals for 2016	**158**

With passage of Senate Bill 350 (SB 350), the California Energy Commission (CEC) is charged with establishing regulations consistent with doubling the level of statewide energy efficiency by January 1, 2030. SMUD is actively participating in this proceeding and seeking acknowledgement of the investments SMUD has already made. Once the CEC regulations are adopted, staff will revisit SMUD's energy efficiency targets and propose changes as necessary.

[2] Emissions have not been verified and are subject to change.
[3] Emissions include emissions from SMUD usage, SMUD System Losses and System Losses by Others.

B. Meet Renewable Goals; Emphasize Local and Regional Benefits

Meeting RPS 2020 & 2030 Targets

Senate Bill 2 in 2011 (SBX1-2) established a RPS obligation of 33% by 2020 for local publicly owned utilities (POUs) as well as retail sellers. SBX1-2 gave the CEC new oversight responsibilities with respect to the RPS requirements for POUs, and included new interim targets leading up to the 33% by 2020 target. SB 350 in 2015 extended the RPS regulation beyond 2020 to include a 50% RPS by 2030.

POUs are required to procure 25% of their retail sales from renewable sources by the end of 2016, and 33% by the end of 2020, 40% by the end of 2024, 45% by the end of 2027, and 50% by the end of 2030. The CEC is currently developing regulations to implement SB 350.

SMUD met the RPS requirement for Compliance Period 2 (CP 2; 2014-2016) with procurement, historic carryover (HCL), and surplus from the first compliance period. As illustrated in Table 3, SMUD applied a total of 6,461 GWh of RPS eligible generation plus 181 GWh of surplus RECs to meet the RPS requirement of 6,642 GWh for CP2.

Table 3 – SMUD's Renewables Goals and Accomplishments

Program	CP 2 Goal (2014-2016)	CP 2 Net Procurement[4]	Surplus Applied	2017 Goal	2020 Target
RPS	21.6%	21.0%	0.6%	27%	33%
RPS (GWh)	6,642	6,461	181	2,750 (est.)	3,300 (est.)

Meeting Future RPS Goals

To continue progress in achieving future RPS goals, staff has conducted a number of procurement efforts in 2016 including the following:

- In 2016, Staff completed the Rancho Seco Solar Project, a 10.88 MW solar photovoltaic facility owned and operated by the Rancho Seco LLC and delivered to SMUD via a power purchase agreement.
- Staff is currently exploring the development of Phase 4 of the Solano Wind Project and the simultaneous repowering of Phase 1, which combined would significantly increase annual energy production of the wind project.
- SMUD staff is currently constructing a new small hydro facility near the current Slab Creek reservoir in the Upper American River Project (For details, see Appendix B).
- SMUD approved a contract for a new 60 MW solar PV facility in the central valley to begin deliveries by the end of 2017.

[4] Net Procurement reflects removal of RPS eligible procurement used to meet Greenergy and Solar Shares.

Renewable Projects, Demonstrations, & Studies

SMUD completed many grant-funded projects, demonstrations, and studies in 2016. A detailed description of these projects is included in Appendix B.

C. Promote Cost Effective Clean Distributed Generation and Storage

Senate Bill 1 (SB1) Solar Status

The residential installed solar capacity increased by 2MW in 2016, while the commercial sector increased nearly 270% (6 MW) from the previous year. As of mid-2016, SMUD had exhausted all of the SB1 Program funds budgeted for residential and commercial installations, and expects to surpass the established 125 MW SB1 program target by the end of 2017.

SolarShares

Participation in the Residential SolarShares program remained strong in 2016, with 98.3% subscribed by year-end. Residential Customers received 1.4 GWh of solar energy through the program.

Plug In Hybrids and Battery Electric Vehicles

SMUD continued its efforts to support and advance plug in hybrids and battery electric vehicles through a variety of activities including the following:

- In the spring of 2016, SMUD launched its residential "Charge Free for a year" program with a $300 per vehicle rebate using Low Carbon Fuel Standard credit derived funding. The program was expanded at the beginning of 2017 to "Charge Free for 2 years" by increasing the rebate to $599.
- As of summer 2017, approximately 5800 plug-in electric vehicles (PEV) are registered in SMUD's service territory.
- As of the spring of 2017, SMUD had eight DC Fast Chargers (DCFC) spread across 6 station sites. The DCFC is now transitioning toward a customer incentive program.
- SMUD's Workplace and Multi-family Charging Infrastructure program is also transitioning to a customer incentive program in 2017 with a target of 200 charging units.
- SMUD acquired 7 Jobsite Energy Management Systems (JEMS) Trouble Trucks that utilize electricity for auxiliary power and boom operation (versus diesel generator power) to reduce emissions and noise. SMUD also has PEV's in its light duty PEV fleet.

4. Recommendation

It is recommended that the Board accept the Monitoring Report for SD-9.

Appendix A – SD-9 History

SD-9, adopted by the Board of Directors in 2014, provides guidance to SMUD staff with goals for carbon mitigation, energy efficiency, and renewable power. In December 2008, the Board added sustainable power supply as the overall objective of the integrated resource planning (IRP) process. The objective's stated goal is the reduction of SMUD's long-term GHG emissions for serving retail load from its current state to 10% of its 1990 GHG emission levels by 2050 (i.e. - <350,000 metric tons/year).

The 2009 policy revision (Resolution 09-11-08) advanced the RPS target to procure 20% of SMUD's annual energy sales from renewables by 2010 (instead of 2011), and added a target of 33% annual energy sales met by renewables by 2020. Subsequently in May 2011, the Board added interim GHG targets for years 2012 and 2020, to establish a trend toward long-term GHG goals, and clarification for alternatives to achieve targets and goals.

SD-9 directs electric energy, renewable energy supply, and clean distributed generation policy through the year 2020. The directive also contains requirements for an IRP process to achieve these directives and balance them with other policies including financial, customer, local environmental impacts, and reliability directives. SMUD will continue its IRP process focusing on achieving the long run resource planning goals established by SD-9.

SD-9 also includes cost effective demand reduction resources (e.g. distributed storage, demand response, direct load management, and time-of-use pricing) as tools available to meet demand reduction goals. Accordingly, demand reduction goals will be updated after staff gains more insight into demand reduction program capabilities from pilot program studies currently under development through the various initiatives.

AB 2514 required the governing board of each local publicly owned electric utility (POU) to initiate a process to determine appropriate energy storage targets, if any, for the utility by before March 1, 2012. AB 2514 specifically provides that all procurement of energy storage systems must be cost effective. These targets were to be achieved by December 31, 2016, and December 31, 2020, if energy storage was determined to be cost effective.

In accordance with AB 2514, on March 1, 2012, the Board initiated a process under which staff considered energy storage options through the IRP. Based on the IRP findings in 2014, staff determined that an energy storage target was not justified because it was not cost effective. Accordingly, on September 4, 2014, the Board determined that adoption of an energy storage target was not appropriate. AB 2514 requires, the Board to re-evaluate its determination of appropriate storage targets at least every three years. In 2017, SMUD staff reevaluated an energy storage goal for the 2020 target date and recommended an energy storage procurement goal of 9 MW by 12/31/2020. The 2020 goal recommendations focused on distributed energy storage solutions for residential and commercial customers including battery energy storage and thermal energy storage. SMUD's Board of Directors approved the recommended 2020 storage goal in October 2017.

SMUD is also monitoring and supporting plug-in vehicle market adoption given that these technologies reduce GHG emissions in our community and have other grid benefits.

Appendix B – Detailed Project Descriptions

Table B-1 summarizes energy and demand savings from SMUD's residential and commercial energy efficiency programs.

Table B-1 – Comparing 2016 Energy and Demand Savings with SD-9 Goals

Program Type	Avg. Demand Savings (MW 4-7PM)	Energy Savings (Annual GWh)
Information & Education Savings	5.82	21.17
Existing Residential	19.74	73.12
Existing Commercial	8.36	63.91
New Construction	1.8	10.62
Shade Trees	0.17	0.37
Total	***35.89***	**169.19**
SD-9 Goals for 2016	***28.54***	**158**

Table B-2 details accomplishments for various energy efficiency programs SMUD offers.

Table B-2 – 2016 Energy Efficiency Program Accomplishments

Measures & Projects	Results
LED/CFL Bulbs Sold	1,195,391
LED/CFL Fixtures Sold	227,242
Shade Trees Planted	14,067
Old Refrigerators Recycled	5421
Residential HVAC Installations	3696
Multifamily Retrofits Completed	1269
Commercial Projects Through Express Energy Solutions	777
Whole House Fans Purchased	1054
Efficient Room Air Conditioners Purchased	1630
Commercial Projects Completed Complete Energy Solutions	195
Residential Retrofits Completed	1200
Efficient Clothes Washers Purchased	169
Efficient Refrigerators Purchased	439
Custom Commercial Projects Completed	82
Residential Heat Pump Water Heaters Installed	101
Efficient Clothes Dryers Purchased	19
New Efficient Commercial Buildings Constructed	20

New Residential Time-Of-Use Rates

On June 15, 2017, the Board approved a new time-based rate design to better align SMUD's rates with the cost of service. Officially called, Time-of-Day rate or TOD rate, this rate will become the standard residential rate in 2019. For the utility, power is typically most

expensive to purchase between 5 p.m. and 8 p.m. on weekdays, especially in the summer, when air-conditioning use is high. The TOD rate will help incentivize customers to shift electricity consumption to lower-cost times in the day. Staff expects a 75-megawatt peak demand reduction in year 2019 due to the TOD rate.

The transition to the TOD rate will begin with a soft launch in the fall of 2018, with most customers moved by April 2019, and all customers moved no later than December 2019. Beginning in 2018, the TOD rate will be required for all Net Energy Metering customers who are approved for new rooftop solar system installations after December 31, 2017.

Existing Demand Response Programs

SMUD maintains a number of operation-ready load management programs, as summarized in Table C-3. These programs are available to Energy Trading & Contracts (ET&C) and Grid Planning & Operations for reliability purposes. In 2016, SMUD used demand response resources 5 times.

The PowerDirect program (Commercial AutoDR) continues to be an operational resource for ET&C. A range of 2.23 MW to 6.67 MW was realized when it was used 4 times during the summer for price response[5]. The program is planned to continue to grow by 5 MW in 2017 and 2018.

One of SMUD's largest industrial customers was asked to curtail load in August 2016 due to a reliability event, resulting in 7.18 MW load reduction.

SMUD's Peak Corps Program (residential air conditioning load management) remains a resource to SMUD and can be used in emergency situations if the need arises. Peak Corps adds value by contributing toward SMUD's resource adequacy requirements. Each summer, the program is "nick tested" by the grid operations staff to ensure the resource is working and to validate the load reduction potential. In 2016, 69 MW of load reduction was realized at 100% full shed (slightly higher than forecasted load reduction due to the higher outdoor temperature during the test).

Table B-3 - Available Demand Response Programs

Dispatchable Programs	**Expected Load Shed Range (MW)**
Residential Air Conditioning Load Management • At participants maximum elected level of cycling (full cycling) • At 100% full shed (emergency shed)	 41 60
Industrial Curtailment (One customer)	6.5
PowerDirect (Commercial AutoDR)	14 - 17
Total	**61.5 — 83.5**
Non-Dispatchable Programs	**Expected Load Shed Range (MW)**

[5] NERC WebDADs report.

Temperature Dependent Rate • Air Products • Linde	 0 - 9.5 0 - 6.5
Total	**0 - 16.0**

New Demand Response Program Offerings

- The residential PowerStat pilot carried over active participants from 2015 and continued to test multiple program designs. A conjoint study, focusing on the impact of various design elements and program recommendations, was completed in an effort to identify opportunities for making DR more cost effective for SMUD. A challenge that DR continues to address is the need to align the costs of a residential DR program to the low-end market value for capacity. In 2016, PowerStat continued as a residential pilot program and had 6,163 active participants during its maximum enrollment in June, for a total of 8.38 MW of enrolled capacity. Fifteen Conservation Days were dispatched. Survey results continue to show greater than 95% customer satisfaction. The PowerStat treatment groups continue to test program options that include incentives, dynamic pricing, override limitations and number of Conservation Days. A variable dispatch schedule was introduced in 2016 for the no opt-out study treatment groups, testing load impact reduction, load snapback effects, and customer acceptance. The PowerStat Pilot ended in 2016. The pilot will be evaluated in 2017 and results from the pilot will help inform future program offerings, refine recruitment strategies, and adjust program designs to reduce the program costs to align with the market value for capacity.

- In 2016, a Direct Load Control Switch pilot was launched to test two-way communicating switches for residential customers. The pilot tested the technology under field conditions and evaluated installation, connectivity and device performance. Results were used to inform a planned broad deployment to replace Air Conditioning Load Management (ACLM) switches. The objective is to upgrade ACLM's one-way switch with the new 2-way technology and enroll the participants into new program offerings. The objective is to provide a firm load demand response resource that Energy Trading & Contracts can use during the summer for system reliability and economic dispatch. The Demand Response Management System received the planned Silver Spring Networks' HAN Communication Manager upgrade. This upgrade will now support direct-to-grid two-way air conditioner switch technology.

Peak Load per Customer

SMUD's projected normal weather peak load for 2017 is 4.76 kW per customer account. Load per customer is a metric used to monitor the effectiveness of SMUD's efficiency and demand reduction programs. Historic load per customer data can be found in Table C-4.

Table B-4 – Actual and Weather-Normal Peak per SMUD Customer (kW)

Year	Actual	Normal Weather
2010	5.01	4.99
2011	4.75	4.97
2012	4.9	4.95
2013	4.95	4.86
2014	4.9	4.86
2015	4.8	4.86
2016	4.80	4.81
2017[6]	5.05	4.76

Grant Funded Renewable Projects

- Distributed Resource Energy Analysis and Management System Development for Real-time Grid Operations – SMUD played a monitoring and advisory role in Hawaiian Electric Company's addition of new capabilities to their energy management system. These modifications enabled the visibility of thousands of uncontrolled distributed rooftop PV resources and allowed for greater short-term wind and solar forecasting. This project was completed in mid-2016.
- Improving the Accuracy of Solar Forecasting – This project, completed in 2016, was to develop an advanced solar power forecasting system. The findings from SMUD's benchmarking work helped inform the University Corporation for Atmospheric Research (UCAR) targets for their enhancements. UCAR is the data warehouse for all commercial solar forecast vendors. The vendors take UCAR's data and improve it to meet the needs of their customers. SMUD provided crucial information for improving UCAR's models. UCAR was able to cut the error rate by 20%. These improvements will be incorporated into SMUD's commercial solar forecasts used by Energy Trading.
- Pre and Post Combustion NOx Control with Microwave Energy – Under the grant awarded by the CEC, CHA Corporation built and field-tested a pre- and post-combustion NOx control system at CleanWorld's BioDigester Facility at South Area Transfer Station in Sacramento. A six-month field-test was successfully completed in January 2017. Throughout the field-testing period, the average NOx emission did not exceed 5 ppm. This confirmed the pre- and post-combustion NOx control would meet the California Air Resources Board rule 1110.2 and its 2007 NOx emission standards.

Renewable Energy Studies

[6] The year to date system peak load of 3,140 MW was reached on Monday, June 19, 2017. The system peak occurred on the fourth day of a seven-day heat storm. The daily high and low temperatures were 106 and 77 degrees Fahrenheit, respectively, measured at the Sacramento City and Executive Airport weather stations. The forecast of SMUD's system peak under extreme (1 in 5) weather conditions is 3,146 MW which is slightly higher than the observed system peak demand of 3,140 MW. The normal weather system peak forecast includes the expected impacts of energy efficiency programs, behind the meter PV installations and EV battery charging.

Note: 2015 and 2016 Normal Weather Peak loads were revised.

- Wind Resource Site Evaluations – These projects included analysis for potential wind plant development in North Lassen, South Lassen, and Abert Rim. The analysis completed in 2016 found the project to be uneconomic.
- Quantifying the Externalities of Renewable Generation – The analysis, completed in 2016, focuses on quantifying the difficult to measure benefits of renewable generation. These positive externalities include things, such as, impacts to water usage and reduction in GHG.
- Feasibility of Solar PV and Biogas Storage Integration – SMUD initiated a study on the feasibility of solar PV and biogas storage integration. The objectives of the study are to model the optimum performance of a hybrid biogas-photovoltaic system and assess the project feasibility. This study was completed in 2016; the results indicate further studies are needed.

Carbon Offset Demonstration and Protocol Development Projects

SMUD is exploring ways to sequester carbon in and around its service territory. Here is a summary of the current research agenda:

- Biosequestration – Based on initial local carbon offset project development and regional carbon neutrality research conducted in 2013 and 2014, staff is conducting more detailed research into the potential for public-private partnerships to accelerate carbon sequestration in the region. In 2016, staff began working with the Sacramento Area Council of Governments and Sacramento County to add a carbon sequestration analysis to a planned open space inventory study. SMUD is also working with regional partners to develop a draft assessment of sequestration potential in Sacramento County.

- Delta Carbon Capture & Wetlands Farming – SMUD collaborated with several agencies on the development of a GHG methodology for wetlands and rice farming in California. Following scientific and public review in 2016, the American Carbon Registry approved the final protocol in the spring of 2017.

- Placer Forest Sustainability Initiative – SMUD partnered with the Placer County Air Quality Management District to conduct research and develop GHG offset protocols for forest fuel management activities. This project developed tools that can quantitatively account for the ecosystem services and carbon emission savings. In addition, this work will allow for the increased pace and scale of management activities to reduce existing forest fuel load and utilization of forest biomass wastes for renewable bioenergy production. A draft protocol for avoided wildfire emissions underwent peer review in 2016 and is expected to be presented to the American Carbon Registry in August of 2017.

Climate Change and Carbon Reduction Research Projects undertaken in 2016 SMUD Marginal Emissions Factor – To better understand the GHG emissions implications of operational and program decisions as well as investments in renewables, energy efficiency, and electrification, SMUD undertook an update of its marginal emissions factor and associated marginal costs. This work will assist in overall program planning, historical data tracking and reporting, and forward-looking scenario planning. The research for this project was completed in 2016.

- Short-Lived Climate Pollutant Research and Program Development – Based on research on regional short-lived climate pollutants conducted in 2015, staff worked with SMUD Custom Solutions during 2016 to design a pilot natural refrigerant incentive program for commercial customers. The incentive is designed to address the significant first costs of natural refrigerant systems. The program was launched in March of 2017.
- Climate Readiness Update and Operational Plan – ER&D monitors scientific literature and new findings related to the long-term physical impacts of climate change and report findings every four years. In 2016, an updated scientific assessment and readiness action plan was completed. This work supports SMUD's participation in the US Department of Energy's Partnership for Energy Sector Climate Resilience and the Capital Region Climate Readiness Collaborative.
- Fugitive Emissions Analysis – Upstream GHG emissions, which occur during the production, processing, and transportation of natural gas, are widely considered significant though challenging to quantify. In 2016, ER&D completed initial estimates of the upstream GHG emissions associated with SMUD's natural gas consumption.

Water & Energy Assessment and Demonstration Projects

- SMUD funded four demonstration projects in partnership with local water agencies. The City of Sacramento leveraged the SMUD-funded pilot study to win a $2.5 million dollar Department of Water Resources grant to expand their leak detection and repair program.
- In conduit/In stream Technology Assessment – This study explored low-impact in-conduit hydro opportunities that can be deployed within the water utility systems located within SMUD's service area. This assessment was completed in 2016, with the identified sites and technologies proving to be uneconomic.

Additional Opportunities

New South Fork Powerhouse and Boating Flow Valve Project – Staff continues moving forward with a Department of Energy (DOE)-funded project to add a new, small hydroelectric powerhouse near Slab Creek Dam. The new powerhouse would produce on average approximately 10 GWh annually, generated from new and higher minimum releases that are required at Slab Creek Dam under the new UARP license. Staff filed a Final Non-Capacity License Amendment Application with Federal Energy Regulatory Commission (FERC) for the new powerhouse in September 2014. FERC amended the UARP license, authorizing SMUD to construct the project. All other necessary permits have been secured. Following Board approval, staff has contracted with McMillen Jacobs Associates to build the powerhouse. Construction of the project commenced in May 2017 and is expected to conclude at the end of 2018

Plug In Hybrids and Battery Electric Vehicles

A residential light duty electric vehicle "Free Charging for a Year" incentive program was launched in May 2016, with a $300 per vehicle incentive to cover the cost of electricity for one year. The program was expanded to "Free Charging for Two Years" at the beginning of 2017. These incentives are supported by Low Carbon Fuel Standard credits sales earned through the California Air Resources Board program. As of spring 2016, approximately 5600 PEV's are registered in SMUD's service territory.

Four more DCFC stations were opened in 2016 bringing SMUD's total to 6 DCFC stations. Two of the locations have two DCFCs installed. The locations are listed below:

- SMUD Headquarters (1 DCFC Station)
- Raley's Citrus Heights (1 DCFC, 2 Level 2's)
- Sacramento International Airport (1 DCFC, 2 Level 2's)
- Sacramento Food Cooperative (1 DCFC, 2 Level 2's)
- Sacramento Valley Station (2 DCFCs)
- Nugget Market Elk Grove (2 DCFCs, 2 Level 2's)

The program is transitioning to a customer incentive program in 2017. The incentive is set at $100,000 per site to cover the cost of the charging hardware and basic installation labor.

- SMUD's Workplace and Multi-family Charging Infrastructure pilot was completed in April of 2017. The program achieved 45 of the planned 48 charger installations in the pilot effort and the program has transitioned into a full customer program in 2017.

SMUD also supported the City and County of Sacramento to develop EV readiness plans. These efforts also helped the community respond to the Volkswagen Electrify America program where Sacramento was selected as the Green City for additional EV related investment. The VW Green City investment will be targeted toward electric share cars in the region.

Senate Bill 1 Solar Status

As of mid-2016, SMUD has exhausted all of the SB1 Program funds budgeted for residential and commercial installations. On July 5, 2016, SMUD moved to a contractor stipend payment of $500 to assure the installation of PV production meter equipment. Table C-5 summarizes SMUD's progress by year in the five market sectors covered by the SB1 program.

Table B-5 – Installed and Expected PV under SB1 Program[7]

	Residential Retrofit		Solar Smart Homes		Solar Shares & Multifamily Affordable VNM[8]		Commercial Retrofit		Totals	
	Installed Systems	MW	Installed Systems	MW	Installed Systems	MW	Installed Systems	MW	Installed Systems	MW
2007	55	0.2	105	0.2	0	0	5	0.3	165	0.7
2008	73	0.2	255	0.5	1	1.1	10	1.5	339	3.3
2009	215	0.8	188	0.4	0	0	12	4.2	415	5.4
2010	368	1.5	222	0.5	1	0.5	20	8.9	611	11.4
2011	611	2.3	154	0.4	0	0	39	8	804	10.7
2012	752	3.4	298	0.8	3	0.1	29	7.6	1,082	11.9
2013	1,310	6.2	656	1.4	0	0.0	33.0	5.5	1,999	13.1
2014	1,410	7.0	476	1.0	0	0.0	43.0	2.3	1,929	10.3
2015	3,108	15.2	172	0.4	0	0.0	24.0	3.6	3,304	19.2
2016	3,445	17.9	0	0.0	0	0.0	29.0	9.5	3,474	27.5
Totals	11,347	55	2,526	5	5	2	244	51	14,122	113

SolarShares

SMUD began delivering on 10 MW of SolarShares sales in September 2016 and signed contracts with other large commercial customers to deliver another 4 MW in 2017. The SolarShares program is currently being marketed to large commercial customers and the residential and small commercial SolarShares offerings are being redesigned for release in January 2019.

[7] The Commercial Retrofit quantity increased. Current quantity reflects interconnection points rather than number of projects. Three multifamily projects had multiple interconnection points. Revised numbers more closely reflect the DOE EIA826 report. Solar Smart Homes was recalibrated after the close of that program in 2015. Quantities in 2016 reflect straggling installations from previous year commitments.

[8] Virtual Net Metering